Fact Sheet

GROUND FREEZING AS A BARRIER FOR CONTAMINATED SOILS AND GROUNDWATER

PROBLEM

A low-cost, effective method is needed to immobilize contaminants in soils and groundwater until they can be treated and removed. Treatment techniques for some contaminants are still being developed, while others, such as pump and treat, are expensive and can take many years to complete.

SOLUTION

Ground freezing has been used for at least 100 years for groundwater seepage control, particularly in sinking shafts, tunneling, and responding to environmental emergencies. We are developing techniques and monitoring methods to ensure the integrity of frozen barriers so that they may be used effectively to immobilize contaminants. Artificially frozen ground also may help concentrate or clean some contaminants through selective migration before an advancing frozen wall or in combination with other treatment methods.

During ground freezing, ice between soil particles increases soil strength and decreases soil permeability. Two freezing methods have been used: 1) slow-rate freezing or closed-loop systems using coolants such as calcium chloride brine, ethylene glycol, or ammonia; and 2) fast freezing or open-loop systems using expendable coolants such as liquid nitrogen. Advantages of ground freezing include the following:

- No additives to soil (i.e., few environmental concerns).
- Proven in industry for purposes other than hazardous waste containment.
- Can be turned on or off during an emergency if cooling coils are incorporated.
- Can control wall thickness by temperature adjustments and by the installation of additional freeze pipes

RESULTS

CRREL supported the Oak Ridge National Laboratory (ORNL) in Oak Ridge, Tennessee, to determine the feasibility of using a 2- to 5-ft-thick frozen barrier to completely surround a tritium-contaminated waste disposal trench. This will prevent groundwater migration out of or into the contaminated area and immobilize tritiated groundwater long enough to allow for its radioactive decay.

At Hanford, Washington, we are providing technical support in the use of frozen barriers to remediate radioactive-contaminated wastes. DoE adopted the ground freezing technology as a barrier and further demonstrations are planned.

POINTS OF CONTACT

Dr. Iskandar K. Iskandar
603-646-4198
Fax: 603-646-4448
E-mail: iskandar@crrel.usace.army.mil

Dr. Steven A. Grant
603-646-4446
Fax: 603-646-4561
E-mail: sgrant@crrel.usace.army.mil

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US Army Corps of Engineers®
Cold Regions Research & Engineering Laboratory

CRREL, 72 Lyme Road, Hanover, NH 03755-1290
http://www.crrel.usace.army.mil